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Ohio W-R 25 and Ohio W-R 29: TWO NEW DISEASE-RESISTANT, UNIFORM-RIPENING, PINK, GREENHOUSE TOMATO VARIETIES

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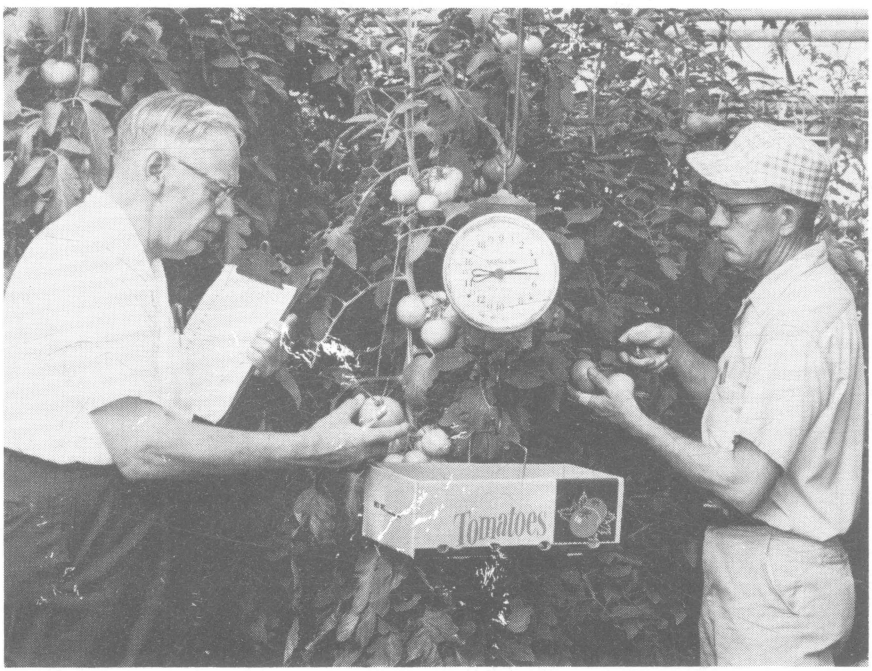

OHIO AGRICULTURAL EXPERIMENT STATION
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Ohio W-R 25 and Ohio W-R 29:

Two New Disease-Resistant, Uniform-Ripening, Pink, Greenhouse Tomato Varieties

Leonard J. Alexander

INTRODUCTION

The tomato variety most commonly grown in Ohio for the past several years has been Ohio W-R 7. This variety, introduced by Alexander (2), is high producing and good quality. It is resistant to Race 1 of the wilt organism, *Fusarium oxysporum f. lycopersici*, blotchy ripening, fruit pox, and is tolerant to high soil manganese. Disadvantages of Ohio W-R 7 are that the fruits tend to crack badly under certain conditions and in hot weather the internal color tends to be a light shade of red.

Cracked fruits are seriously degraded in value or rejected by buyers. This is due partly to unsightliness of the fruit but especially because of waste resulting from fruit rotting, disease-producing microorganisms entering through cracks. Such fruits are usually referred to in commercial trade as leakers. Frequently a leaking, rotting fruit will quickly spoil an entire package. Young (7) has discussed the nature of cracking.

In an attempt to correct these defects, a breeding program was initiated. The primary purpose was the production of a new variety with all disease resistance and good horticultural qualities of Ohio W-R 7 and less susceptibility to fruit rots and breakdown because of cracking. It was also desirable, if possible, to produce a variety with better internal color.

SELECTION OF PARENTS

In a breeding program designed to transfer desirable genes, such as disease resistance, to an otherwise good commercial variety, the use of the backcross method is advantageous. At the time that this breeding program was started, the standard greenhouse variety was Ohio W-R Globe, introduced by Alexander (1) in 1947. So it was planned to use this as the recurrent parent. However, by the time the first backcross was made, it became evident that Ohio W-R 7 would become the preferred variety. Thus, after the initial cross, Ohio W-R 7 was used as the recurrent parent.

In a backcross breeding program, the major characteristics of the donor parent are not important as long as it possesses the desirable gene or genes which are to be transferred to the recurrent parent. For the next cross, however, it is necessary to select and use only those plants which possess the gene or genes being transferred.

In the present work, the variety Sioux, introduced by Werner (6), was chosen as the donor parent. This variety was selected because Sioux fruits have a pleasing internal red color, possess the uniform ripening gene, and seldom exhibit radial cracks. The plants tend to tolerate high temperatures well. The fruit setting potential of this variety is relatively good when temperatures are high. However, the variety possesses many undesirable characteristics, including susceptibility to Fusarium wilt, blotchy ripening, concentric cracks, small fruits, and an indeterminate type of growth.

PEDIGREES OF NEW VARIETIES

The pedigrees of both varieties are similar. In the first cross, Ohio W-R Globe was used as the female parent. In subsequent crosses, the recurrent parent, Ohio W-R 7, was used as the male parent.

Varieties which possess the uniform ripening gene tend to crack less and to exhibit a more uniform color when ripening. So it was desirable to introduce this gene into the new varieties. Since the uniform ripening and colorless skin genes are recessive to green shoulders and yellow skin, one cross and one backcross to the recurrent parent were made in succession. It was necessary to self the progenies at least once after the backcross. Plants which exhibited fruits with colorless skin and uniform ripening were homozygous for these characteristics and were used for an additional series of backcrosses to good type.

Ohio W-R 25 was derived from the following crosses and selections: ({[(Ohio W-R Globe x Sioux) x Ohio W-R 7]-1-2-2 x Ohio W-R 7} x Ohio W-R 7) -BK-1-1-BK-BK.

Ohio W-R 29 was derived from the following crosses and selections: ({[(Ohio W-R Globe x Sioux) x Ohio W-R 7]-29-2-1 x Ohio W-R 7} x Ohio W-R 7) -BK-1-11-11-BK.

After the last bulk selections, the seed of both varieties was multiplied and small samples of each were distributed to 100 growers for trial. Some growers sent yield records to the Ohio Agricultural Experiment Station for evaluation.

DISEASE RESISTANCE IN NEW VARIETIES

At the beginning of the long-time breeding program to develop a disease-resistant variety for greenhouse culture in Ohio, it was decided to use the best variety available and add disease-resistant genes as they became available. With Ohio environmental conditions and market preferences, Livingston's Globe, introduced by A.W. Livingston in 1905 (3), came closest to being the most desirable variety available. It was improved by selection by Hoffman in 1940 (4) and called Strain A Globe.

In developing Ohio W-R Globe, Strain A was used as a good type parent. When the I-gene for resistance to *Fusarium oxysporum f. lycopersici* Race 1 was added, this produced Ohio W-R Globe. This is a Livingston Globe type which is highly resistant to Race 1 of the Fusarium wilt organism. In addition to Fusarium resistance, Ohio W-R Globe possesses tolerance to the high manganese soil content in northeastern Ohio. Furthermore, it is moderately resistant to blotchy ripening and fruit pox. Apparently these latter three desirable characteristics were present in the original Livingston's Globe variety in a heterozygous condition.

No known data is available concerning the inheritance of manganese tolerance or fruit pox resistance. However, observational evidence strongly indicates that they are heritable. Jones (5) presented good evidence that blotchy ripening is heritable.

In an attempt to produce a more nearly globe shaped fruit and to eliminate all blotchy ripening and fruit pox, certain breeding lines used in the production of Ohio W-R Globe were crossed in all combinations. These attempts resulted in Ohio W-R 7, which had the following disease-resistant characteristics:

a. High resistance to Race 1 of the Fusarium wilt organism

b. High resistance to blotchy ripening

c. High resistance to fruit pox

d. Good tolerance to high soil manganese

The next desirable step was to improve the variety for resistance to cracking and better internal color. The crosses indicated earlier were made, resulting in the development of the two new varieties described in this paper. These varieties have these two new valuable characteristics:

a. Low incidence of cracking

b. Uniform ripening

The advantages of a variety with a low incidence of cracking are obvious. The uniform ripening gene of fruits contributes to a low inci-

dence of cracking At the same time, it eliminates the unsightly green shoulders which fail to color properly in hot weather or when exposed to direct sunlight

BLOSSOM-END ROT OCCURRENCE IN NEW VARIETIES

In certain seasons, blossom-end rot is a serious problem in commercial greenhouse tomatoes. Care is taken to introduce new varieties that are at least as resistant as Ohio W-R 7 Until the fall crop of 1963, it was believed Ohio W-R 25 and Ohio W-R 29 were equal or superior to Ohio W-R 7 in this respect.

During the fall of 1963, however, the weather was extremely dry and relative humidity was extremely low throughout the state. The rainfall deficiency at Wooster was 13 40 inches in 1963.

In late September and early October, it was observed that blossom-end rot under these drought conditions was somewhat more severe in Ohio W-R 25 than in Ohio W-R 7. Moreover, when the fruit of the first cluster, and to some extent the second, ripened, some tended to exhibit a glossy appearance. When cross-sectioned, an internal breakdown was found No evidence of pathogenic organisms could be demonstrated and the trouble was attributed to internal blossom-end rot.

A trace of the trouble could be found in both Ohio W-R 7 and Ohio W-R 29. With the exception of some diseased fruits on the first and second clusters, the fruits on the remainder of plants were good quality and free of blossom-end rot.

GENERAL CHARACTERISTICS OF NEW VARIETIES

Fruit Shape: The shape of the fruit of both Ohio W-R 25 and Ohio W-R 29 under average environmental conditions can best be described as globose Under some environmental conditions, however, the fruit may be somewhat ovate and under others slightly oblate. See Figures 1 and 2.

Internal Color: Under most conditions, the fruits of both varieties have the darkest color of any of the Livingston Globe types

Firmness: Plants producing firm fruits were selected each time over those with less firm fruits. The result was that both of these new varieties are equal or slightly superior to Ohio W-R 7. Increased firmness should result in better shipping and longer shelf life.

Smoothness: Fruits of the two varieties tend to be smooth The fruits of Ohio W-R 25 are fairly uniform with few odd shapes. Thus they tend to produce a high percentage of No 1 tomatoes.

The fruits of Ohio W-R 29 are more like Ohio W-R 7 Under good growing conditions, the fruits are smooth and globose. Under adverse

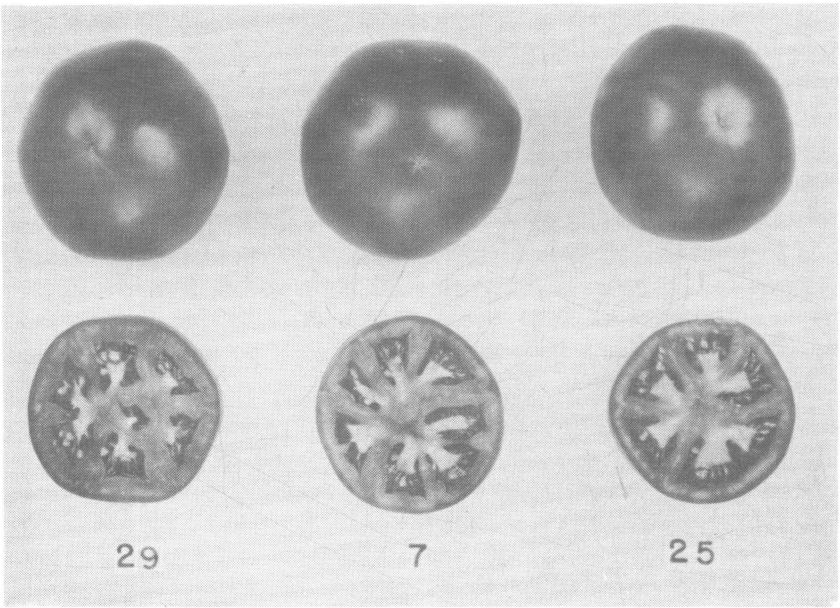

Fig. 1.–Interior and exterior views of Ohio W-R 29, Ohio W-R 7, and Ohio W-R 25.

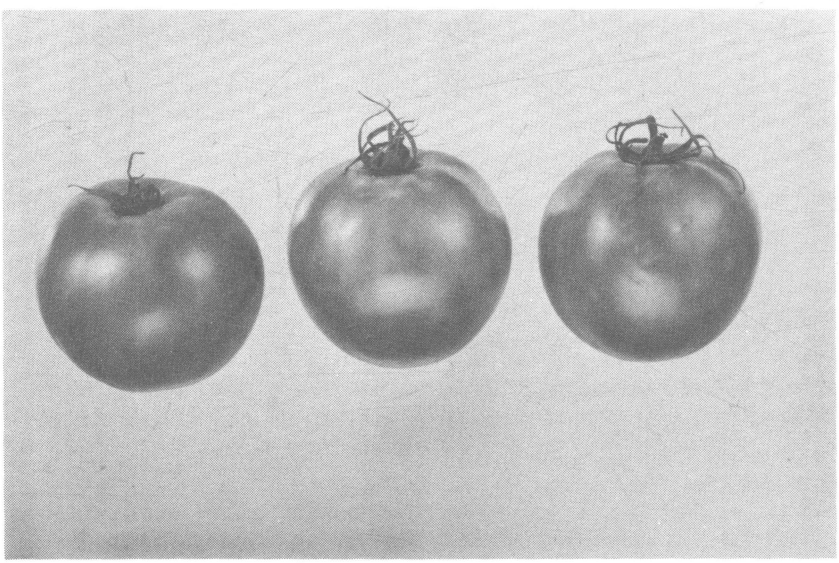

Fig. 2.–Shape of new varieties and old variety. Left, Ohio W-R 25; center, Ohio W-R 29; and right, Ohio W-R 7.

conditions, however, they tend to produce a higher percentage of No. 1 large fruit and more off-shaped fruits than Ohio W-R 25, especially early in the season.

Plant Vigor: Plants of the two varieties differ in vigor. Ohio W-R 29 is similar to Ohio W-R 7. If it differs from Ohio W-R 7, it is probably slightly more vigorous. Because of this tendency, care must be exercised to avoid overwatering the plants early in the spring crop season.

In contrast to this, Ohio W-R 25 is somewhat less vigorous. Care must be taken to apply enough water to prevent the plants from becoming too non-succulent or woody and thus setting more fruits than the plants can support. If the plants become too woody, they do not grow vigorously enough to set fruits on upper clusters.

Temperature: Temperature requirements are similar for all disease-resistant globe types.

Fruit Setting: In general, it is easier to get fruits to set on plants of Ohio W-R 25 than on either Ohio W-R 29 or Ohio W-R 7. This is probably due to the fact that Ohio W-R 25 is a slightly less vigorous grower than either Ohio W-R 7 or Ohio W-R 29.

Maturity: The maturity of the two new varieties is similar to Ohio W-R 7 but Ohio W-R 25 may be a little earlier.

COMPARATIVE YIELD RECORDS OF OHIO W-R 7, OHIO W-R 25, AND OHIO W-R 29

One advantage of a backcross breeding program is that it is usually not necessary to yield test a proposed new variety over a long period or over a wide range of conditions.

Yield tests from the breeding plots were obtained from the Paul Ruetenik and Son Greenhouse, Vermilion, Ohio; the greenhouse of the Ohio Agricultural Experiment Station, Wooster; and Mueller & Sons Greenhouses, located a short distance north of Cincinnati. These three test areas represented the Lake Erie region, north central Ohio, and the southern Ohio River area.

Data for the spring crops in the breeding plots are presented in Table 1. In the spring crop, the yield of Ohio W-R 25 and Ohio W-R 29 exceeded Ohio W-R 7 yield by about 13.0 and 8.3 percent.

Yields obtained from the fall crops are presented in Table 2. In the fall crops, Ohio W-R 25 outyielded Ohio W-R 7 by the considerable margin of 17.6 percent. However, in this case, Ohio W-R 29 yielded less than Ohio W-R 7.

Before a new tomato variety is released to commercial greenhouse growers, samples are sent to a large number of growers for trial. This

practice tests adaptability and relative performance over a wide range of conditions in a short time.

In this case, 100 seed samples of the two new lines were distributed to about 100 greenhouse growers throughout Ohio. Of the growers who grew plants from the seed, 33 sent in yield data. Unfortunately, only 9 growers kept comparative data between the trial lines and Ohio W-R 7. One grower made two tests so data from 10 trials are shown in Table 3.

Data presented in Table 3 indicate that on the average Ohio W-R 25 outyielded Ohio W-R 7 by 8 percent. The yield of Ohio W-R 29 averaged about 1 percent less than Ohio W-R 7.

It is interesting to note that in all 10 commercial comparative trials, Ohio W-R 25 produced a greater yield than Ohio W-R 7. In these commercial tests, the difference in yield between Ohio W-R 7 and W-R 29 is not significant. Furthermore, in some tests one variety was superior and in other tests the other variety was superior. Thus it would appear that in these tests Ohio W-R 7 and Ohio W-R 29 produced similar yields.

FRUIT SIZE OF OHIO W-R 25 AND OHIO W-R 29

Fruits of both Ohio W-R 25 and Ohio W-R 29 compare favorably in size with those of Ohio W-R 7. However, as shown in Table 4, the fruits of Ohio W-R 25 tend to weigh slightly less and those of Ohio W-R 29 tend to weigh slightly more than those of Ohio W-R 7.

These data were calculated from all fruit picked over a complete season in the Wooster plots. The fruits usually are larger early in the season. As the season progresses, fruit size usually tends to decrease.

DISCUSSION AND SUMMARY

Two new greenhouse tomato varieties are described. These varieties are similar to Ohio W-R 7 but have genes added for less cracking, even ripening, and better internal color. Reduced fruit cracking results in better fruit rot control. In addition to these new characteristics, both varieties have all disease-resistant characteristics of Ohio W-R 7.

Production of Ohio W-R 29 appears to be equal to that of the standard variety, Ohio W-R 7. Tables 1, 2, and 3 show that the yield of Ohio W-R 25 exceeded the yield of Ohio W-R 7 by 13.0, 17.6, and 8.0 percent respectively. Based on these results, it appears logical to expect an increased commercial yield of about 10 percent.

Fruit size as measured by weight indicates that fruit of Ohio W-R 25 is slightly smaller and that of Ohio W-R 29 is equal to or slightly larger than that of Ohio W-R 7.

TABLE 1.—Comparative Yields of Ohio W-R 7, Ohio W-R 25 and Ohio W-R 29. Yield Data Collected from Breeding Plots Over a 5 Year Period. Spring Crops.

Location	Year	Pounds Per Plant			Number 8-Pound Baskets Per Acre		
		Ohio W-R 7	Ohio W-R 25	Ohio W-R 29	Ohio W-R 7	Ohio W-R 25	Ohio W-R 29
Wooster	1959	15.4	20.7	16.9	18,600	25,000	20,400
Wooster	1960	14.0	16.3	____	17,000	19,800	____
Wooster	1961	10.4	____	____	12,600	____	____
Wooster	1962	13.8	17.0	14.4	16,700	20,500	17,400
Wooster	1963	8.6	9.0	9.0	10,400	10,900	10,800
Vermilion	1961	12.1	12.0	12.7	13,200	13,100	14,000
Vermilion	1963	10.6	12.3	____	10,400	12,000	____
Cincinnati	1961	11.9	10.1	12.9	13,400	11,400	14,500
Corrected Average Pounds Per Plant		12.10	13.67	13.01			
L. S. D. 0.10= 1.38							
Percentage Increase Over Ohio W-R 7			13.0	8.3			

TABLE 2.–Comparative Yields of Ohio W-R 7, Ohio W-R 25 and Ohio W-R 29. Yield Data Collected from Breeding Plots Over a 4 Year Period. Fall Crops.

Location	Year	Pounds Per Plant			Number 8-Pound Baskets Per Acre		
		Ohio W-R 7	Ohio W-R 25	Ohio W-R 29	Ohio W-R 7	Ohio W-R 25	Ohio W-R 29
Wooster	1959	7.9	9.4	6.5	9,500	11,400	7,900
Wooster	1960	8.7	9.7	7.9	11,500	11,800	9,500
Wooster	1961	7.2	—	6.8	8,800	———	8,200
Wooster	1962	8.6	10.3	8.6	10,400	12,500	10,400
Vermilion	1960	5.5	6.1	—	6,000	6,600	———
Vermilion	1961	5.7	—	6.0	7,200	———	7,600
North Olmsted	1961	7.0	—	7.6	8,900	———	9,700
Corrected Average Pounds Per Plant		7.4	8.7	6.9			
L. S. D. 0.01 = 1.10							
Percentage Increase or Decrease of Ohio W-R 7			17.6	–6.8			

TABLE 3.–Comparative Yields of Ohio W-R 7, Ohio W-R 25, and Ohio W-R 29. Yield Records Collected by Ohio Commercial Greenhouse Growers. Spring Crop 1962.

	Grower	Average Pounds Per Plant		
		Ohio W-R 7	Ohio W-R 25	Ohio W-R 29
1	1	13.4	14.3	12.4
	2	14.8	16.0	14.0
	3	11.9	12.6	10.1
	4	11.8	12.4	13.1
	5	12.3	12.9	12.3
	6	9.1	10.8	9.1
	6A	9.1	10.4	9.5
	7	16.9	18.4	17.2
	8	13.9	14.3	14.4
	9	11.5	12.6	11.1
Average Pounds Per Plant		12.5	13.5	12.3
L. S. D. 0.01 = .73				
Percentage Increase or Decrease of Ohio W-R 7			8.0	– 1.0

TABLE 4.–Comparative Weights of Fruits Ohio W-R 7, Ohio W-R 25, and Ohio W-R 29.

		Ohio W-R 7		Ohio W-R 25		Ohio W-R 29	
Year	Season	Number Fruits	Average Weight Ounces	Number Fruits	Average Weight Ounces	Number Fruits	Average Weight Ounces
1962	Spring	1755	6.42	2356	6.27	2178	6.20
1962	Fall	542	5.07	728	4.55	487	5.67
1963	Spring	259	5.29	632	4.54	256	5.60
Average Fruit Weights			6.02		5.64		6.06

LITERATURE CITED

1. Alexander, L. J. 1949. Ohio W-R Globe: A New Wilt-Resistant Glasshouse Tomato Variety. OAES, Res. Bull. 689, 19 pp.

2. Alexander, L. J. 1957. Ohio W-R Seven, A New Disease Resistant Globe-Type Glasshouse Tomato Variety. Phytopathology 47: 515 (Abstr.).

3. Boswell, V. R. 1937. Improvement and Genetics of Tomatoes, Peppers and Eggplant. U.S. Dept. of Agriculture. Yearbook of Agriculture 1937, pp. 176-206. U.S. Government Printing Office, Washington.

4. Hoffman, I. C. 1940. Progress in Greenhouse Vegetable Breeding: Varieties. Proc., Ohio Vegetable and Potato Growers Assoc., p. 103.

5. Jones, J. P. 1958. The Relation of Certain Environmental Factors, Tobacco Mosaic Virus Strains, and Sugar Concentration to the Blotchy Ripening Disease of Tomato and the Inheritance of the Tendency to the Disease. Ph.D. dissertation. The Ohio State University, Columbus. 72 pp.

6. Werner, H. O. 1944. Description of Two New Tomato Varieties. Red Cloud and Sioux. Hort. Progress Report No. 6, Neb. Agr. Exp. Sta., Lincoln. 8 pp.

7. Young, P. A. 1963. Symptoms and Control of Tomato Fruit Cracking. Plant Dis. Reptr. 47: 523-527.